Synthetic Resin Structures and Mountings for Such Structures

Field of the Invention

The present invention relates generally to building materials, and more specifically to processing methods and aesthetically pleasing load-bearing structural designs using synthetic resin based imitation wood products such as, for example, trimboard composed of a laminated polyvinyl.

Background of the Invention

In home construction finishing, wood is often used due to its workability, economy, structural strength and desired appearance. However, wood is susceptible to a number of potential dangers that may shortly degrade its structural fitness and aesthetic appearance. For example, the effects of moisture, changing temperatures, UV light and insects may cause wood used in a very visible location to swell, rot, split, cup, craze or weaken.

Imitation wood products have been developed from synthetic resins such as, for example, cellular polyvinyl chloride (PVC) materials, and are being marketed for use as trimboards, cornerboards and/or beadboards. Such materials have characteristics including water and insect resistance, fire retardance, and workability with the same tools as would be used with wood. They are typically comprised of cellular plastic cores and densified covering layers that impart the appearance of wood grain to the synthetic resin workpiece. The cellular synthetic resins are commonly referred to as "structural foam material" or "integral foam material". A wide range of resins can be used, but preferred are polyvinylchloride, polystyrene, polyethylene, polypropylene, polyester, polycarbonate and the like. Some examples of commercially available synthetic resin based products include KOMA™ (U.S. Pat. No. 4,141,944) trimboards marketed and distributed by Kömmerling Kunststoff GmbH (Huntsville, AL, www.komatrimboards.com, www.kommerling.com), and AZEK™ trimboards manufactured by Vycom Corp. (Moosic, PA, www.azek.com.)

Such synthetic resin products are commercially available in widths ranging from 5/8" to 5/4", which is perfectly acceptable for trim applications, but there is an unsatisfied need for building materials having the excellent properties of such synthetic resin products in certain load-bearing applications such as, for example, railings, fences, gazebos, etc. The strength requirements of such structures has typically necessitated use of traditional building materials, but many of the synthetic resin based products have specific gravities (*e.g.*, 0.45 to 1.5 gm/cm^3) comparable to real wood.

Pleasing aesthetics drives much of consumer choices in selecting building materials. Fasteners such as screws, nails and bolts that are externally viewable in finished constructions are needed when using many types of conventional building materials. The resiliency of synthetic resin materials allows certain manipulations that are not possible with real wood products. Advantageously employing such processing of the synthetic resin boards to create structures which show little to no signs of external fasteners in structural applications would therefore most likely be met with customer approval and demand.

It is an objective of the present invention to address these unmet needs. It is additionally an objective of the present invention to provide several structural designs that eliminate the need for externally viewable fasteners and associated mechanical supports that enable use of the synthetic resin based products in load-bearing structures.

Summary of the Invention

The inventor has developed implementations and accessories for the synthetic resin based boards described above. The present invention provides inventive methods for producing a polyvinyl product meeting the needs described above, and structural assemblies that enable use in structures such as, for example, pergolas, picket fences, railings, gazebos, etc. Such plastics can be assembled on site using lower level labor and even ordinary consumer skills, and structures having enhanced aesthetics can be easily transported, assembled and disassembled.

In one aspect, the present invention provides a method of producing a synthetic resin based support member that in some embodiments is formed of a laminate material that is highly durable, aesthetically pleasing, and suitable for construction projects wherein

no screws or nails are externally visible. In preferred embodiments, the invention makes use of PVC-based trim board materials that are commercially available in varying thicknesses that may, if necessary, be mitered or otherwise processed to form laminates comprised of adhered trim board layers. Various means of adhering the trimboards may be employed. Such laminates exhibit increased stiffness and strength, as well as an improved resistance to microcracking after a prolonged period of use in the field. The composite structure also generally exhibits an increased longitudinal shear strength. The structure also exhibits increased axial load strength proportional to the thickness and number of trimboard layers employed. After formation, the composite laminate may then be employed as workable components in a wide range of assemblies.

In another aspect, the present invention provides various means of using the laminate in structures such as railings with increased structural support. In one embodiment, sections of laminate intended to be used as hand rail supports are reinforced with rigid segments of material such as aluminum.

In another aspect, the present invention provides various means for attaching trimboards composed of any material, advantageously the inventive laminates but not limited to said laminate materials, to corners or windows in a manner in which no fasteners (e.g., nails or screws) are externally visible. These embodiments employ rigid clip mechanisms that allow use of trimboards in both new constructions and retrofits, and provide increased stability to structures such as windows over existing window trim installations, which typically simply abut the window.

In yet another aspect, the present invention provides railing assemblies that have reinforcing cores within foldable sheath-like hollow railing columns or posts, such as may be used in decking. The hollow post may have any cross-sectional shape, but is preferably square or rectangular. The reinforcing core may be used with posts formed of the inventive laminate so as to show no external screws or nails, or may be used more generally with other building materials. The reinforcing core makes use of a plurality of symmetrically disposed positioning screws to properly orient the post it is reinforcing. The reinforcing core also includes a bottom plate for securing the reinforcing core to a floor, ground or deck surface.

Common to each application of the synthetic resin (e.g., KOMA or AZEK) workpieces having imitation wood textures surfaces is the ability to be able to fold the workpiece so as to form seamless, non-planar profiles. Each workpiece has at least one

joint at which the workpiece is foldable. Each joint includes a (e.g., mitered or otherwise formed) groove in the workpiece defined by two mateable surfaces that converge at a central axis of the joint very near the surface with the imitation wood texture. In preferred embodiments, each of these mateable surfaces interlock so that slippage does not occur.

In various embodiments, the workpieces are foldable into support members having a variety of solid or hollow polygonal cross sectional areas or other structural assemblies. One example is a corner trim assembly that exhibits a seamless profile and no externally viewable fasteners. In such an assembly, the workpiece is foldable at a right angle so as to form a seamless corner trim profile having an imitation wood texture. The corner board may be glued or cemented to a building surface, or one or more rigid, preferably metallic, clips may be employed to secure the corner board to the building's surface with no external evidence of fasteners. This is achieve by locating a portion of the clip(s) attached to the corner board underneath preexisting or to be installed siding or shingling. Each such clip is comprised of a thin plate, one portion of which is positioned between the corner board and the building surface, and another portion of which is secured to the building surface but hidden from external view by shingling or siding that is temporaily removed during a retrofit or to be added in new constructions. Each of the clips also has at least one flange extending normal to the plate surface that snugly fits or snaps into a corresponding one of the at least one recess in each of the two workpiece surfaces. Other means of fastening or adhering the plate to the corner board and/or building surface, such as gluing or cementing, may be used alternatively or additionally.

In a preferred embodiment, each surface internal to the fold (i.e., on the surface of the corner board adjacent the building) has a plurality of recesses or grooves parallel to the joint along the length of the corner trim board. These recesses and grooves may be dimensioned slightly wider internally than at the surface in order to more securely receive the corresponding flanges of the clips, which terminate in nubs or tines.

Brief Description Of The Figures of the Drawing

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the accompanying drawing and detailed description, wherein:

Figure 1 is an illustration of a composite laminate structure in accordance with the present invention;

Figures 2A,B are schematic diagrams of a railing system in accordance with the present invention;

Figures 3A,B are schematic diagrams of a support column component in a railing assembly;

Figure 4 is a schematic diagram of a top cap to be affixed atop a support column in a railing assembly;

Figure 5 is a cross-sectional view of a laminate sheet that has been mitered to exhibit preferred grooves in accordance with the present invention;

Figures 6A-6D are illustrations of a variety of forms that may be created by folding mitered sections of laminate in accordance with the present invention;

Figures 7A-C are schematic illustrations of components of a post reinforcement mechanism in accordance with the present invention;

Figures 8A-B are top and side views of a trimboard corner mounting assembly in accordance with the present invention; and

Figures 9A-E are schematic illustrations of the components of a window trim mounting assembly in accordance with the present invention.

Detailed Description of Preferred Embodiments of the Invention

Preferred embodiments of the present invention will now be described with reference to the several figures of the drawing.

In one aspect, the present invention provides a method of producing a laminate material that is highly durable, aesthetically pleasing, and suitable for construction projects wherein no screws or nails are externally visible.

The invention makes use of PVC-based trimboard materials, such as those described above, in their commercially available sizes (*i.e.*, up to 1" thick) to create a multilayer laminate comprised of multiple layers of the trimboard. With reference to **Figure 1**, each layer of trimboard **2** adjacent another is fastened to the other via one or more of a variety of means. Because the trimboard material is robustly workable, the trimboards may be affixed to one another by conventional nailing and/or screwing. In a preferred embodiment, adjacent layers **2** are bonded via construction adhesive or PVC

cement, such as commercially available 2P-10™ manufactured by FastCap, LLC (Bellingham, WA, www.fastcap.com), or Gorilla Glue™ (U.S. Pat. No. 4,675,354 to Sperling) manufactured by Gorilla PVC Cement LLC (Hollywood, FL, www.gorillaglue.com.) These glues are invisible, quick-setting and suitable for indoor or outdoor uses, and may be employed in bonding the laminate to materials such as wood, stone, metal, ceramics and other plastics. The laminates are easily painted prior to use in laminate assemblies, but preferably after an assembly has been completed (so as not to interfere with proper dimensioning of sub-assemblies.)

A fine bead of adhesive **4** is preferentially placed along the center **6** of the planar interface **8** between adjacent trimboards, in such a manner as to prevent excess adhesive from seeping out from the layer between any two trimboards. The cited adhesives are also easily sanded, which may be necessary following a laminate cutting operation. The trimboard surfaces at the laminate interface may be smoothed mechanically or chemically, or otherwise processed, to maximize delamination resistance.

A composite laminate structure **10** prepared in accordance with this invention exhibits an increased stiffness and strength in a direction normal to the planar interface between trimboards, as well as an improved resistance to microcracking after a prolonged period of use in the field. The composite structure also generally exhibits an increased longitudinal shear strength. The structure also exhibits increased axial load strength proportional to the thickness and number of trimboard layers employed.

After formation, the composite laminate may then be employed as workable components in a wide range of assemblies. One such assembly, a railing system, is now described with the assistance of **Figures 2A-4**. The figures specify dimensions that a purely suggestive and by no means meant to be limiting.

Figure 2A illustrates a railing assembly **20** and several views of components thereof, including a handrail **22**, a baluster rail **21**, a plurality of balusters **24**, a support column **30**, and a bottom rail **23**. All components are preferably manufactured from composite laminate material, and dimensioned so as to be assembled together snugly. Handrail **22** has been beveled to create an ornamental design that also allows a person to comfortably grip the handrail. The handrail also has been mitered to form a notch **26** into which baluster rail **21** will be glued and/or fastened via screws or nails through holes **28** from the bottom of baluster rail **21** out of the field of view of a person standing or sitting proximate to the railing assembly **20**. Bottom rail **23** has a corresponding notch **27** into

which one end of each of the plurality of balusters **24** is inserted, thereby receiving alignment and vertical support from the bottom rail **23**. The respective other ends of each of the plurality of balusters are secured to the baluster rail **21**, preferably by gluing.

Figure 2B illustrates an end view of railing assembly **20** wherein the handrail **22** and bottom rail **23** have been optionally reinforced by channels **102** and **104**. Channels **102** and **104** are comprised of a rigid, durable material such as, for example, aluminum, that increases the horizontal stability of the handrail and bottom rail. Channels **102** and **104** may comprise a single or multiple sections of material that runs the entire length of the rail or a shorter portions thereof where horizontal forces (such as persons leaning against the rail) are of particular concern. The channels **102** and **104** are mateably received by the corresponding notches **26** and **27**, respectively. Each contacting flange end point **106** may be tined to assure a tighter mechanical grip, but the primary mechanism for adhering the channels will be fasteners **108** extending through holes (not shown) in the channels into the corresponding rail. The fasteners may be the same fasteners (*e.g.*, screws or bolts) that adhere the railings to the railing posts.

Figures 3A and **3B** present several isolated views of support column **30**, which provides support for baluster rail **21**. Depending upon the assembly requirements, support column **30** may be solid or have a wholly or partially hollow core **34**. The support column also has a notch **32**, for receiving an end of baluster rail **21**. The baluster rail may simply be glued into the notch **32**, or additionally (or alternatively) a washer **36** and screw **38** may fasten the baluster rail to the support column. **Figure 3B** indicates, but does not show, where the handrail **22** and a column cap **40** would be connected to the baluster rail **21** and support column **30**.

Figure 4 illustrates one embodiment of a top cap **40**, comprised of top assembly **44** which is secured (preferably by gluing) to a bottom assembly **42**, which in turn is fastened (also by gluing) to the top of support column **30**. Several features of the top cap **40** are worth noting. First, bottom assembly **42** is optionally beveled along edge **46** in such a manner as to allow mating to the beveled surface **28** of top rail **22**. This provides a seamless fit and additional interface surface area over which an adhesive may be applied to secure the bottom assembly **42** to handrail **22**. Second, bottom assembly **42** includes a notch **48** for integral connection with baluster rail **21**. Third, bottom assembly **42** may be hollow to allow access during installation to other components to which the bottom assembly is to be secured.

Figure 5 shows a cross-sectional view of a laminate sheet that has been mitered to exhibit shaped grooves **112**. While various shaped grooves (*e.g.*, more curved or displaying more angled features) may be used, the pattern illustrated is particularly useful in allowing a single piece of laminate to be folded into a variety of shapes that exhibit nearly seamless combination. As shown, the grooves do not go all the way through the laminate, but is cut sufficiently deep so as to allow folding of the laminate sheet. When the sheet is folded, glues and epoxies as described above are applied to the contact surfaces **114** to assure mechanical strength.

Figures 6A-6D illustrate just a sampling of the structures that can be formed by adjust the groove angles **116** and spacings **118** between the grooves. **Figure 6A** illustrates a solid beam formed from the folded sheet. **Figure 6B** illustrates a variation that may be suitable for use as the support column **30** of the railing system above. **Figure 6C** illustrates a variation that may be used as a decorative covering to concrete columns in imitation of a Roman style. Each of these shaped components can be made of any desired length, and may be used, for example as a decorative collar-like finish **120** to a post or column **122**, such as illustrated in **Figure 6D**.

With reference to **Figures 7A-C**, the present invention also provides a reinforcement mechanism **124** that is especially suited, though not limited, to providing reinforcement to support columns having a hollow core (such as reflected by reference character **34** of column **30** in **Figure 3B**) that have been formed of the laminate described above. The reinforcement mechanism comprises a core column **126** of a sturdy material such as, for example, aluminum that has dimensions such that it will fit within the hollow column in close proximity, but not contacting the inner the walls of the column or post being reinforced. The core column **126** is mated to bracket or plate **130** through features such as flanges **134** and grooves **136**. The plate **130** is fastened by a carriage bolt **132** through a hole **133** to whatever surface the post and reinforcement mechanism **124** are to be supported by (*e.g.*, a deck, concrete slab, etc.) Once the core column **126** is positioned within the post to be reinforced. A plurality of threaded leveling screws **138** are inserted through threaded holes **128** positioned symmetrically about the sides of the core column **126**. The leveling screws **138** are then turned until they contact the inner surface of the hollow post (not shown), and adjusted until the proper orientation of the post has been achieved. Although a square post and one set of four leveling screws near the top of the core column **126** are illustrated, other shapes and leveling screw configurations are

possible. If the folded laminate described above is employed as the post material, the result is a sturdy post with no nails or screws externally viewable.

With reference to **Figures 8A-B**, the present invention also provides a means for mounting trimboard such as the laminate described above to corners of structures such as houses in a manner that no nails or screws are external exposed. **Figure 8B** provides a side view of a bracket **146** having a plurality of flanges **148** that are dimensioned so as to fit snap snugly into a corresponding plurality of mitered kerfs **142** in the back side of a corner section **140** of trimboard. The flanges **148** may have tined ends **150** to further secured the flange within the kerfs. The bracket **146** is formed of a rigid, durable material such as, for example, aluminum, and has one or more holes **146**. The assembly is positioned at the desired corner with the brackets flush with the house wall surface, and fasteners (*e.g.* nails, not shown) are insert through the holes, securing the trim assembly to the house corner. As shown, the kerfs may extend along a portion of the back side of the trim corner longer than the width of the bracket, in order than the corner trim may be adjusted to the desired position before fastening. After fastening, the end of the bracket **144** having the hole is then covered by whatever shingling is being applied to the house, thereby completely hiding all corner trim attachment means. Although not shown, the flanged bracket concept is not limited to corner trim, and may be extended to fascia or bead board mounting.

The present invention also provides a means for installing new or retrofitting any type of trim around windows in a more secure manner, and in a manner that overcomes limitations of conventional window trim. Conventional window trim is limited to configurations that abut the window. If an installer wishes to more tightly secure the trim to a window, the installer of conventional trim will most likely have to drill into the window, having the economic consequence of voiding the window manufacturer's warranty. Additionally, installers are currently limited to installing only the trim provided by the window manufacturer. The present invention allows installation of any style and/or quality of trim to any window.

With reference to **Figures 9A-E**, a window trim mounting assembly is comprised of one or more pairs of brackets **150, 152** for securely mounting a window trimboard **154** to a window **156**. The first bracket applied is bracket **152**. Some windows, notably ANDERSON WINDOWS™, are assemble with a groove **160**, such as shown in a top view of the mounting assembly in **Figure 9C**, that extends along the perimeter of the

window. First bracket **152** has an optional flange **158** for insertion into the window groove **160.** If the window being trimmed has no such groove, then a version of first bracket **152** that has no flange **158** will be employed. The groove and flange serve as a natural alignment means. A surface **162** of the first bracket **152** is positioned snugly flush against the side surface of window **156** while the first bracket **152** is fastened to the wall **168** by one or more fasteners **166** (*e.g.*, nail or screw) through hole(s) **164**. This provides reinforcement for the positioning of the window in the wall. Then second bracket **150** is connected to trimboard **154** through a flange feature **170** that is received by a corresponding first kerf **172** in the trimboard **154.** This sub-assembly is then slid along the surface of the wall **168** where a second flange **174** of the first bracket **152** is received by a second kerf **176** in the trimboard **154**. Once the trim board has been properly positioned with respect to the first bracket **152** and window **156**, the second bracket **150** is secured to the wall **168** by one or more fasteners **178** through a corresponding number of holes **180**. Once the entire mounting assembly has been secured, with perhaps multiple pairs or brackets judiciously disposed about the perimeter of the window (**Figures 9D-E** show front and back view of such placements), the exposed portion of the second bracket **150** can then be covered with whatever shingling is being used on the house exterior, thereby hiding all indications of nails or screws. The foregoing describes a mounting assembly in accordance with the present invention that provides additional structural support for a window and the ability to apply any type of trim to the window in a new installation or a retrofit environment.

Although the invention has been described with respect to certain specific embodiments, it should be realized this invention is also capable of a wide variety of further and other embodiments within the spirit and scope of this invention.

I claim: